



## FOR ANSWERING QUESTIONS

### **Update: Reports of Four Human Infections with Swine-Origin Influenza A (H3N2) Viruses Showing Genetic Reassortment with 2009 H1N1 Virus. September 9, 2011**

#### **Summary**

- On September 6, 2011, CDC confirmed two additional cases of human infection with swine-origin triple reassortant H3N2 viruses, bringing the total number of cases in Pennsylvania to three.
- A "Have You Heard" Update was posted to the CDC media relations website at [http://www.cdc.gov/media/haveyouheard/stories/lab\\_testing.html](http://www.cdc.gov/media/haveyouheard/stories/lab_testing.html).
- These cases were identified as part of an ongoing investigation by CDC and the Pennsylvania State Department of Health into an initial Pennsylvania case of swine-origin trH3N2 virus infection.
- The Pennsylvania Health Department has published information about these cases on their website at <http://www.pa.gov/portal/server.pt/community/media/3013>.
- Information on the first case in Pennsylvania was published on September 2, 2011 in a Morbidity and Mortality Report (MMWR) Early Release entitled "Swine-Origin Influenza A (H3N2) Virus Infection in Two Children – Indiana and Pennsylvania, July-August, 2011." The article is available on the [MMWR website](#).
- In addition to the details of the case in Pennsylvania, that MMWR reported that a swine origin influenza A (H3N2) virus had been detected in a child in the state of Indiana as well.
- In the three Pennsylvania cases, there appears to be direct contact with swine. Human to human transmission of this virus is suspected in the Indiana case.
- The patients in the three Pennsylvania cases all attended the same agricultural event, where they reported contact with swine.
- Investigation into the sources of exposure and contacts of the ill patients and other fair attendees is ongoing.
- There is no epidemiological link between the cases in Pennsylvania and the case in Indiana.
- Swine influenza A (H3N2) viruses normally infect pigs. These viruses rarely infect humans. However, human infections have occurred, usually following exposure to infected pigs.
- Genetic sequencing of viruses in all four cases has shown a genetic variation in these viruses.

- This change is the acquisition of the Matrix gene, or “M” gene, from the pandemic 2009 H1N1 virus in place of the original M gene in the swine-origin triple reassortant H3N2 virus.
- The M gene plays a role in influenza virus infection, assembly and replication, but the significance of this change in these swine-origin trH3N2 viruses is unknown at this time.
- CDC is continuing to investigate the implications of this genetic change.
- These cases from Indiana and Pennsylvania bring the total number of reports to CDC of human infection with swine-origin trH3N2 virus since 2009 to 12. However, these four most recent reports are the first cases of human infection with a swine-origin trH3N2 virus with the M gene segment from a 2009 H1N1 virus.
- Surveillance for both seasonal and novel influenza viruses is conducted by CDC and state and local health partners year-round.
- In 2007, human infection with a novel influenza A virus became a nationally notifiable condition in the United States. Novel influenza A virus infections include all human infections with influenza A viruses that are different from currently circulating human influenza H1 and H3 viruses. These viruses include those that are subtyped as non-human in origin and those that are unsubtypable with standard methods and reagents.
- International Health Regulation (IHR) reports were submitted for these cases per the World Health Organization reporting requirements in the event of a human infection with a novel or animal-origin influenza virus.
- Clinicians who suspect influenza virus infection in humans with recent close contact with swine should obtain a nasopharyngeal swab from the patient, place the swab in a viral transport medium, contact their state or local health department to facilitate transport and timely diagnosis at a state public health laboratory, and consider empiric neuraminidase inhibitor antiviral treatment.

#### Case 1 (Indiana)

- A medically fragile male child with multiple co-morbidities became ill with influenza-like symptoms (fever, cough, congestion, fatigue and diarrhea) on July 23, 2011. The patient has since returned to baseline health status.
- The child had received influenza vaccine in September 2010, and was not treated with influenza antiviral medications.
- The child was seen at a local emergency department on July 24, 2011. A nasopharyngeal swab specimen tested positive for influenza A (H3) and was forwarded to the Indiana State Department of Health for further testing as part of routine CDC-supported influenza surveillance.
- Testing at the Indiana State Department of Health identified suspect swine-origin triple reassortant influenza virus and the specimen was sent to CDC for further characterization.

- On August 18, 2011, the Influenza Division at CDC used PCR to determine the specimen was a suspect swine-origin triple reassortant influenza A (H3N2) virus; this was confirmed on August 19 by genetic sequencing.
- Genetic sequencing revealed reassortment between previously isolated swine-origin trH3N2 virus and the pandemic 2009 H1N1 virus; one of the eight gene segments (the "M" gene) of the trH3N2 influenza virus from this Indiana case was borrowed from the 2009 H1N1 virus.
- This case is the first recognized case of human infection with swine-origin triple reassortant influenza A (H3N2) virus with the M segment gene from the pandemic 2009 H1N1 virus to date.
- An International Health Regulation (IHR) report was submitted on August 20, 2011, per the World Health Organizations reporting requirements in the event of a human infection with a novel or animal origin influenza virus infection.
- There is no reported contact between the patient and swine in this case. However, a home health nurse of the child reported frequent swine contact in the weeks prior to his illness onset.
- The situation in Indiana is suggestive of human to human transmission of this virus. No additional illness was identified in the caretaker, her family or close contacts, or the pigs she contacted.

#### Case 2 (Pennsylvania)

- A female child with a history of premature birth and mild asthma became ill with influenza-like symptoms (fever, cough and fatigue) on August 20, 2011. The patient has since recovered from her illness.
- The child had received influenza vaccine in September 2010, and was not treated with influenza antiviral medications.
- The child was taken to a local hospital emergency department on August 20, 2011, where a rapid influenza diagnostic test was positive for influenza A.
- Nasopharyngeal swab and nasal wash specimens were forwarded to the Pennsylvania Department of Health Bureau of Laboratories as part of routine CDC-supported influenza surveillance.
- On August 23, 2011, diagnostic testing of the specimens at the state laboratory indicated suspect swine-origin influenza A (H3N2). Both specimens were forwarded to CDC for further characterization.
- On August 26, 2011, the Influenza Division at CDC used genome sequencing to determine the virus was swine-origin triple reassortant influenza A (H3N2) virus with the M gene from the pandemic 2009 H1N1 virus.
- No epidemiologic links between this case and the Indiana case were identified.

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- An investigation into the source of the exposure revealed direct contact between the patient and swine. (The patient's parent reported visiting an agricultural fair four days before the onset of symptoms.)
- An International Health Regulation (IHR) report was submitted on August 26, 2011 per the World Health Organizations reporting requirements in the event of a human infection with a novel or animal origin influenza virus infection.

#### Case 3 (Pennsylvania)

- A female child became ill with influenza-like symptoms (fever, abdominal pain, and vomiting) on August 21, 2011. The patient did not see a clinician for her illness and continues to recover.
- The child had received influenza vaccine during the 2010-2011 influenza season, and was not treated with influenza antiviral medications.
- As part of an ongoing investigation into the initial case of swine-origin triple reassortant influenza A (H3N2) virus infection in Pennsylvania, this child's illness was identified and a nasopharyngeal swab specimen was collected and forwarded to the Pennsylvania Department of Health Bureau of Laboratories.
- Testing at the state laboratory was inconclusive and the specimen was sent to CDC for further characterization.
- On September 2, 2011, the Influenza Division at CDC used partial genome sequencing to indicate that the virus had NS, HA, and M gene segments consistent with the swine-origin triple reassortant influenza A (H3N2) virus identified from the previous Pennsylvania and Indiana cases.
- An investigation into the source of the exposure has revealed direct contact between the patient and swine. (The patient exhibited market hogs at an agricultural fair from August 13 – 20, 2011.)
- Though direct exposure to swine has been confirmed, further investigation of the patient's contacts to determine any additional illness is ongoing.
- No direct contact between this case and the two other Pennsylvania cases has been identified.
- An International Health Regulation (IHR) report was submitted on September 6, 2011, per the World Health Organizations reporting requirements in the event of a human infection with a novel or animal origin influenza virus infection.

#### Case 4 (Pennsylvania)

- A female child became ill with influenza symptoms (fever, shortness of breath, cough, nausea and vomiting) on August 18 - 19, 2011.

- The child had received influenza vaccine during the 2010-2011 influenza season, and was not treated with influenza antiviral medications.
- A respiratory specimen was obtained on August 25, 2011, as part of routine care, which was identified as an un-subtypeable influenza A by the hospital laboratory. Nasopharyngeal swab and nasal wash specimens were collected.
- On September 3, 2011, the specimen was forwarded to CDC for further characterization.
- On September 5, 2011, the Influenza Division at CDC used genome sequencing to determine the virus was swine-origin triple reassortant influenza A (H3N2) virus with the M gene from the pandemic 2009 H1N1 virus.
- The investigation has revealed multiple potential swine exposures. (The patient's mother reported the patient visited an agricultural fair for four days before the onset of symptoms. The patient also visited a friend who participated as a swine exhibitor at the agricultural fair.)
- Further investigation of close contacts of the child, potential additional sources of the patient's infection and ill contacts of fair exhibitors and attendees is ongoing.
- No contact between this case and the previously reported Pennsylvania cases has been identified.
- An International Health Regulation (IHR) report was submitted on September 6, 2011, per the World Health Organizations reporting requirements in the event of a human infection with a novel or animal origin influenza virus infection.

### **Human Infections with Swine-Origin Influenza Viruses**

- Swine are susceptible to swine, avian and human influenza viruses.
- Swine flu viruses do **not** normally infect humans. However, sporadic human infections with swine flu have occurred.
- Swine-origin trH3N2 viruses were first detected in North American swine herds in the late 1990s.
- Swine trH3N2 viruses commonly circulate in pigs in North America, but only rare cases of human infections with these viruses have been detected.
- These four cases are human infections with swine-origin trH3N2 influenza virus, a virus that normally infects pigs.
- Influenza viruses are constantly changing and it's possible for two viruses to swap genes if a "host" is infected with more than one influenza virus at the same time.
- Most commonly, cases of human infection with swine-origin influenza viruses occur in people who have been in close proximity to infected pigs.

- The viruses in these four cases are different from the 2009 H1N1 virus that has been circulating in the United States since April 2009. The viruses in all four of these cases have acquired the M gene from the pandemic 2009 H1N1 virus.
- Swine-origin trH3N2 virus infections in humans have also been reported from Kansas and Iowa in 2009 and from Minnesota, and Wisconsin and Pennsylvania in 2010. Unlike previous reports of swine-origin trH3N2 influenza viruses, the swine-origin triple reassortant viruses that have been reported to date in 2011 carry the M gene from the pandemic 2009 H1N1 virus.
- These four cases bring the number of human infections with swine-origin influenza viruses reported in the United States to 25 since December 2005, with 12 of these now being infections with swine-origin trH3N2 viruses. However, these are the first four instances of human infection with swine-origin trH3N2 viruses that have the M gene from the pandemic 2009 H1N1 virus.
- From 2005-2007, CDC received reports of approximately one human infection with a swine influenza virus every one to two years, but since 2007, about three to four cases have been reported per year; this increased reporting may partially be because human infection with novel influenza viruses became a nationally notifiable condition in 2007.
- Although the vast majority of instances of human infection with animal influenza viruses do not result in human to human transmission, these cases should be fully investigated to be sure that such viruses are not spreading among humans and to limit further exposure of humans to infected animals if infected animals are identified.
- CDC publicly reports human infections with novel influenza viruses in its FluView U.S. Weekly Influenza Surveillance Report.

#### **Acquisition of the "M" Gene into Swine-Origin trH3N2 Influenza Viruses in Humans**

- Genetic sequencing of swine-origin trH3N2 influenza viruses from Indiana and Pennsylvania indicates that these viruses have acquired the "M" gene from the 2009 H1N1 virus.
- Although reassortments between swine influenza A (H3N2) and 2009 influenza A (H1N1) viruses have been reported in pigs, this particular genetic combination of swine influenza virus segments is unique and is not known to have been identified previously in swine or humans.
- The prevalence of this reassortant virus in swine is unknown.
- The M gene encodes two proteins, which play a role in the structure, replication and maturation of influenza A viruses.
- The significance of this genetic variation is uncertain.
- While the four swine-origin trH3N2 influenza viruses sequenced from Indiana (one) and Pennsylvania (three) are similar in that they all contain the M gene mutation, the viruses are not identical, indicating they were not acquired from a common source.

- The viruses in all these cases are resistant to amantadine and rimantadine, but are susceptible to the neuraminidase inhibitor drugs oseltamivir and zanamivir.

## **Swine Influenza**

- Swine Influenza (swine flu) is a respiratory disease of pigs caused by type A influenza virus that regularly causes outbreaks of influenza in pigs. Swine flu viruses can cause high levels of illness and low death rates in pigs. Swine influenza viruses may circulate among swine throughout the year, but most outbreaks occur during the late fall and winter months similar to outbreaks in humans.
- There are four main influenza type A virus subtypes that have been isolated in pigs: H1N1, H1N2, H3N2, and H3N1. Most flu viruses circulating in pigs are referred to as triple reassortant viruses because these flu viruses contain genes from human, swine and avian influenza viruses.
- Swine influenza viruses are not transmitted to humans by food. You can not get swine influenza from eating pork or pork products. Eating properly handled, cooked pork and pork products is safe.
- Human infection with flu viruses from pigs are most likely to occur when people are in close proximity to infected pigs, such as in pig barns and livestock exhibits housing pigs at fairs.
- Swine flu viruses are thought to be spread from pig to pig mostly through close contact among pigs and possibly from contaminated objects moving between infected and uninfected pigs.
- Signs of swine flu in pigs can include sudden onset of fever, depression, coughing (barking), discharge from the nose or eyes, sneezing, breathing difficulties, eye redness or inflammation, and going off feed. However, some pigs infected with influenza viruses may have no symptoms or mild illness.
- For more information about swine influenza, see "Background Information on Influenza in Pigs" at <http://www.cdc.gov/flu/swineflu>.